RECEIVED
SEP 25 2001

NEI

NUCLEAR ENERGY INSTITUTE

550952

**Steven P. Kraft**
Director,
Fuel Supply and Used Fuel
Management

September 25, 2001

The Honorable Spencer Abraham
Secretary of Energy
U.S. Department of Energy
1000 Independence Avenue, S.W. 7A-257
Washington, D.C. 20585

**SUBJECT:** Nuclear Energy Institute comments on the possible site recommendation for Yucca Mountain (66 Fed. Reg. 23,013 – May 7, 2001, 66 Fed. Reg. 43,851 – August 21, 2001 and 66 Fed. Reg. 45,845 – August 30, 2001)

Dear Mr. Secretary:

The Nuclear Energy Institute (NEI)[1], on behalf of the nuclear energy industry, is pleased to submit these comments to the Department of Energy (DOE) on the possible site recommendation for Yucca Mountain. The nuclear industry strongly supports a decision to recommend Yucca Mountain for development as a repository for commercial used nuclear fuel and radioactive waste from DOE and national defense programs.

The industry supports a Yucca Mountain site recommendation based on three fundamental principles:

1. The sound scientific conclusion that the proposed repository will, through natural and engineered barriers, protect public health and safety;
2. The importance of this project to national energy and environmental policy; and

[1] NEI is the organization responsible for establishing unified nuclear industry policy on matters affecting the nuclear energy industry. NEI's members include all nuclear companies licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel fabrication facilities, nuclear material licensees, and other organizations and individuals involved in the nuclear energy industry.

/

550952

3. The industry's unwavering commitment to safety in managing used nuclear fuel.

The scientific and engineering information presented by DOE during this five-month public comment period is the culmination of a 20-year, $7 billion site characterization project. This project has involved thousands of the nation's brightest scientific and engineering minds and earned the respect of the international scientific community. This information provides convincing evidence that a repository at Yucca Mountain will protect public health and safety in accordance with the Environmental Protection Agency's (EPA) radiation protection standard (40 CFR Part 197). In fact, the engineering and science reports released by DOE earlier this year constitute a preliminary determination that the Yucca Mountain site is suitable.

DOE's final suitability determination on Yucca Mountain, informed by public comment, should support a recommendation to President Bush that the site be developed and that DOE proceed to the next step in the process – license applications to the NRC to build the repository for underground disposal of commercial used nuclear fuel and radioactive waste from DOE's defense facilities. The NRC's rigorous licensing process will independently evaluate the safety of a repository before disposal operations can begin.

The Energy Department's science-based suitability determination is an integral part of an environmentally responsible energy policy. Nuclear energy plants supply 20 percent of the nation's electricity efficiently and reliably without emitting any air pollutants or greenhouse gases. Nuclear technology is vital to our nation's energy security as well as our nation's defense. Safe disposal of the byproducts of both commercial and defense nuclear activities is, therefore, essential to the national interest.

The nuclear industry has achieved an impeccable safety record. Our commitment to safety is the foundation of everything we do, and is the principal reason why nuclear power plants have been able to become an increasingly important source of reliable electric generation as our nation's energy needs have grown. This commitment to safety also extends to working with the Department of Energy to ensure safe transportation and disposal of used nuclear fuel at a national repository, where it is more efficiently managed and safeguarded.

The industry's support for a Yucca Mountain site recommendation is further described in our detailed comments in the enclosure to this letter. These comments focus on three areas:

1. The nuclear energy industry's views on the scientific information presented in the *Preliminary Site Suitability Evaluation* and its predecessor reports (*Science and Engineering Report Supplemental*

**550952**

*Science and Performance Assessment Vol. 1 and Vol. 2, and Total System Performance Assessment – Site Recommendation*). These views support the industry's conclusion that the scientific and engineering data in DOE's reports are technically and legally sufficient to support the Yucca Mountain site recommendation decision.

2. Specific responses to questions in DOE's "Suggested Topics For Public Comment" posed in the August 30 Federal Register notice. These questions all center on the topic of whether or not the Yucca Mountain site should be recommended, to which our answer is an unequivocal "yes."
3. Additional information beyond that provided by DOE provides further confidence in the Yucca Mountain site recommendation.

The opportunity for public review and comment on DOE's site recommendation is one of the most important steps in the repository development process. DOE should consider input from constituencies near the Yucca Mountain site as well as the broad scientific community and citizens in the 40 states where used nuclear fuel and the byproducts of defense activities are stored temporarily. As part of the public comment process, we would be pleased to address any questions the agency may have.

Sincerely,

Steven P. Kraft

Enclosure

c: The Honorable Robert G. Card, Under Secretary of Energy
Mr. Lake H. Barrett, Acting Director, DOE OCRWM
Dr. J. Russell Dyer, Manager, DOE Yucca Mountain Project
Ms. Carol Hanlon, USDOE, Yucca Mountain Site Characterization Office

# Enclosure

550952

# NEI Comments on a Possible Yucca Mountain Site Recommendation

**(Including information presented by DOE in the Preliminary Site Suitability Evaluation (PSSE) and its underlying reports, Supplemental Science and Performance Assessment (SSPA), Vol. 1 and Vol. 2, Science and Engineering Report (S&ER), and Total System Performance Assessment – Site Recommendation (TSPA-SR))**

1) **The scientific information presented in the *Preliminary Site Suitability Evaluation* and its predecessor reports supports the nuclear energy industry's conclusion that the scientific and engineering data in DOE's reports are technically and legally sufficient to support the Yucca Mountain site recommendation decision.**

   The PSSE is the capstone document of a 20-year, $7 billion scientific site characterization program. This program has matured to the point where it meets the requirements of the Nuclear Waste Policy Act for completing the site characterization phase of the repository development process and proceeding to the next phase – site approval and construction authorization. The PSSE's thorough and technically credible safety analysis should support the Administration's decision to build a repository at Yucca Mountain. The following comments outline industry's views on these impressive scientific results.

   a) **DOE has presented a credible pre-closure safety case that satisfies the pre-closure suitability criteria of proposed 10 CFR Part 963.**

      As described in Section 2.1 of the PSSE, DOE has built its pre-closure safety case on a solid understanding of proven commercial and nuclear industry technologies. The safety analysis methods described in the PSSE are consistent with those applied in industry. These standards have guided the nuclear industry to an unmatched safety record over the past 20 years. DOE's preliminary analysis effectively applies these widely accepted methods of protecting public health and safety to Yucca Mountain, in accordance with the 10 CFR Part 963 criteria, to provide decision-makers with confidence to move forward to the licensing stage of the repository development process. The NRC licensing process will subject DOE's pre-closure safety case and all subsequent facility operations to the same exacting standards for protection of public health and safety as the nation's 103 operating commercial nuclear power plants.

550952

During the more than thirty-year history of commercial nuclear facilities, the handling and management of used nuclear fuel has become an integral aspect of the operation of these facilities. Day-to-day experience in handling used nuclear fuel has led to safe and efficient techniques and procedures for cask loading and unloading operations.

**b) DOE has presented a credible post-closure safety case that satisfies the post-closure suitability criteria of proposed 10 CFR Part 963 and provides confidence that public health and safety will be protected in accordance with EPA standard 40 CFR 197 for the period of regulatory compliance and beyond.**

DOE has developed a post-closure safety case that provides confidence the repository system will perform as well as or better than DOE compliance assessment calculations indicate. The DOE general safety case relies on several commonly used elements: defense-in-depth, multiple natural and engineered barriers, margin, conservatism, multiple lines of evidence, and natural analogues. The "defense-in-depth" concept and multiple barriers are discussed below in Comment 1d).

Providing "margin" is the practice of ensuring that the results of analysis are well below the regulatory limits, thereby providing greater assurance of compliance. For example, Table 2 in the executive summary of the PSSE shows that peak groundwater concentrations are no more than about 10 percent of the regulatory limits in 40 CFR Part 197, and the doses calculated are less than 1 percent of the 15 mrem/year individual dose limit in 40 CFR Part 197.

"Conservatism" is an analytical approach where the modeler makes pessimistic assumptions about the behavior of one or more aspects of the system behavior. This provides additional confidence that the potential radiological consequences of the potential repository are not underestimated. Analyses presented in the SSPA, and summarized in the PSSE, provide evidence that the DOE compliance calculations are conservative. Thus, radiation levels associated with the repository are likely to be even lower than the current DOE estimates.

DOE, in the PSSE and its predecessor documents, provides multiple, independent lines of evidence to bolster confidence in its understanding and modeling of future Yucca Mountain system behavior. For example, DOE's understanding and modeling of groundwater flow through the unsaturated zone[1] in the system relies on several lines of laboratory and in-situ evidence. DOE measured specific rock properties related to groundwater flow in the

[1] The upper part of Yucca Mountain above the water table.

laboratory, conducted field tests and observations using air pumped into boreholes, and measured rock temperatures as a function of depth. Each of these three activities looked at different characteristics of the unsaturated zone system. DOE developed its model for unsaturated zone groundwater flow consistent with all three sets of observations.

DOE has also identified natural analogues to support its long-term model projections regarding how the Yucca Mountain system will behave. A relevant natural analogue would be some system in which a very long-term process similar to one or more processes active at Yucca Mountain is known to have occurred or is still going on. For example, a geothermal site where heat has driven groundwater movement for many thousands of years could make a good analogue for processes that would be driven by the heat generated by radioactive decay at Yucca Mountain. DOE has used several such geothermal sites throughout the world to improve its ability to model this type of behavior. Additional NEI views on the utility of natural analogues can be found in comment 3e).

**c) DOE's post closure safety case is backed by a depth of scientific investigation and engineering design that supports a suitability determination.**

In the PSSE, DOE recounts the vast amount of work that has gone into the site investigation. Section 3.3 in the PSSE provides only a summary of the major components of the repository system and the supporting analyses that DOE has conducted through the years. Yet this subsection required over 200 pages of the PSSE just to summarize that work. Thus, DOE has provided in the PSSE, and its supporting documents, a detailed and credible description and assessment of the many repository features, events, and processes that are important for assessing the safety of the Yucca Mountain system as a national used fuel and HLW repository. This project has involved scientists and engineers from six major national laboratories, the U.S. Geological Survey, and many universities and private companies. We doubt that there have been any other pieces of land that have been as well studied by as many world-class scientists and engineers as Yucca Mountain. Both the amount and quality of the work that spans a multitude of technical disciplines is truly impressive.

The amount of data collected and level of modeling and understanding of the proposed Yucca Mountain repository system is sufficient to support a suitability determination. As part of the increased level of understanding of the Yucca Mountain system in recent years, DOE has revised the engineering design to take advantage of the latest scientific results on the natural protective features of the site. DOE has provided a total of *five* different

engineered designs (three alternatives in the Viability Assessment and two more in the site recommendation documents). *All* have been shown to comply with the EPA Yucca Mountain radiation standards. By showing that a variety of designs can be used successfully at the Yucca Mountain site, DOE has made a powerful statement about the suitability of the site. Any additional design improvements that DOE may choose to make for the license application will only further bolster confidence in the Yucca Mountain repository system as a whole.

Furthermore, now that the suitability of the site has been assured, DOE's designs provide confidence that either a higher temperature or a lower temperature repository design can be shown to maintain public health and safety. The SSPA analyses showed that neither the degree of uncertainty nor overall performance was significantly different for the two designs. While more could be learned about differences between the two design concepts, significant additional effort directed toward understanding differences between the two design approaches is not necessary for documenting suitability.

**d) DOE's analysis shows that the proposed Yucca Mountain repository would rely on an appropriate mix of natural and engineered barriers to protect public health and safety.**

DOE has identified nine major barriers (four natural and five engineered) within the Yucca Mountain repository system. These barriers protect public health and safety by delaying the release of radionuclides from the repository, reducing the amount of radionuclides exiting the engineered or geologic system, and/or lowering the concentration of radionuclides entering the biosphere.

The use of the barriers that DOE has chosen is supported with data and analyses, thereby providing confidence in a site suitability determination. DOE summarizes how the use of each of the barriers is supported by specific analyses in Table 4-37 of the S&ER. These barriers are summarized below:

- Natural barriers: surface soils and topography; rock layers above the repository; rock layers immediately below the repository; and the rock and soil layers in which the drinking water aquifer resides.
- Engineered barriers: drip shield around the waste containers; waste containers; spent fuel cladding; waste form; and drift invert (material inside the tunnels upon which the waste containers will be placed).

DOE has presented an array of analyses showing how each of these barriers contributes to the protection of public health and safety. These analyses show that there is not an over reliance on one particular barrier. Some of

these barriers, such as the drip shield, have been identified primarily for "defense-in-depth." The "defense-in-depth" approach is used throughout the nuclear industry to ensure that if one system does not function as intended, then another system will compensate for the loss of function.[2] This concept is at the root of the multiple barrier approach to managing long-term uncertainties in repository performance. For example, in the case of the drip shield, the potential performance of the barrier itself is not credited in DOE's analysis. Rather, the drip shield exists to provide additional confidence that, in the unlikely event of waste package failure, repository performance will not be degraded significantly.

Analyses conducted by both DOE and the Electric Power Research Institute (EPRI) show that, while the waste containers are the primary engineered barrier contributing to waste isolation during the regulatory compliance period, other natural and engineered barriers would increase their contribution to overall performance if the waste container function is assumed to be removed. In fact, the EPRI analyses (published in EPRI report 1000802, November 2000) suggest that if the waste container function were neglected entirely, there would be only a small increase in the peak dose rate estimate to individuals in the critical group (this increase would still be well below EPA limits). This provides further evidence that DOE is not relying too heavily on the waste container function or any other barrier to meet regulatory requirements.

**e) The suitability criteria of proposed 10 CFR Part 963 are appropriate to guide DOE's decision-making. These criteria are more protective of public health and safety than the 10 CFR Part 960 guidelines.**

In the proposed Yucca Mountain siting guidelines (10 CFR Part 963), DOE appropriately has developed comprehensive repository evaluation criteria that will be used to make a suitability determination. These criteria will enable decision-makers to effectively evaluate the public health and safety, and environmental protection aspects of the proposed repository by relying on the most advanced scientific methods.

It is appropriate that DOE evaluate the scientific knowledge of the Yucca Mountain site against these criteria at this time even though the 10 CFR 963 rule has not been officially issued in final form. The 10 CFR Part 963 criteria replace the multi-site screening guidelines of 10 CFR Part 960 in the Yucca Mountain decision-making process. Congress removed the purpose of the 10 CFR Part 960 guidelines–to facilitate the evaluation of multiple candidate nuclear waste repository sites–in 1987 by directing

[2] This characteristic has also been termed "robust" performance in the sense that the system can withstand a variety of deleterious events or processes and still meets its required overall safety requirements.

DOE to evaluate only Yucca Mountain. 550952

In the 19 months since the comment period on the proposed Part 963 closed in February 2000, DOE has had ample time to evaluate input received. Over the past year, the only obstacle preventing a finalizing of these criteria has been the issuance of the EPA standard with which the criteria must be consistent. The EPA standard was finalized on June 13, 2001–leaving a series of NRC and DOE concurrence and administrative processes to be complete before the criteria can be considered a "final rule." Given that there was never a requirement in the Nuclear Waste Policy Act to promulgate these criteria as a rule (a point we address in more detail below, and the criteria are now substantively "finished," DOE's use of these criteria at this time is appropriate.

In proposed 10 CFR Part 963, DOE developed comprehensive repository evaluation criteria as called for by Section 113 (b)(1)(A)(iv) of the NWPA. These criteria will enable decision-makers to evaluate the public health and safety aspects of the proposed repository by relying on the most advanced scientific methods. This could not have been accomplished using the siting guidelines of 10 CFR Part 960.

The 10 CFR Part 960 rule established guidelines for choosing a repository from among multiple candidate sites in accordance with the 1982 NWPA. The underlying purpose for these comparative selection guidelines was removed when, after 4 years of study at 9 sites, the 1987 Amendments to the NWPA directed DOE to study a single site, Yucca Mountain, for consideration as a potential repository. More importantly, the 10 CFR Part 960 guidelines did not provide for the use of a comprehensive repository total system performance assessment, but are instead fundamentally built upon an evaluation of discrete subsystem parameters within the repository system.

The National Academy of Sciences (NAS), in a 1995 report entitled *Technical Basis for Yucca Mountain Standards,* recommended the total systems approach. Unlike information that was available to DOE in the early 1980s when 10 CFR Part 960 was written, the NAS was able to rely on the latest scientific knowledge. Having studied modern analytical techniques, and drawing upon considerable international scientific expertise, the NAS strongly recommended against the use of subsystem performance requirements such as those contained in the 10 CFR Part 960 guidelines. In this regard, the following passage from page 13 of the NAS report is particularly significant.

> We conclude that because it is the performance of the total system in light of the risk-based standard that is crucial, imposing sub-system performance requirements might result in sub-optimal repository design.

Following the NAS's lead, EPA based its repository individual radiation protection standard in 40 CFR Part 197 (issued June 13, 2001), on the total systems approach. Because, as recognized in the PSSE, any determination of suitability must consider the ability of the proposed repository to meet regulatory requirements and any suitability criteria used must be consistent with EPA's standard. (NRC is conforming its repository regulations in 10 CFR Part 63 to the EPA standard).

DOE may be criticized for not having completed its final rulemaking on these criteria before considering a site recommendation. However, there is no legal basis for this criticism. Section 113(b)(1)(A)(iv) of the NWPA requires, "criteria to be used to determine the suitability of such candidate site for the location of a repository, developed pursuant to Section 112(a) of the Nuclear Waste Policy Act." Nothing in the NWPA requires DOE to establish such criteria by rulemaking or as a prerequisite to site recommendation consideration hearings. The fact that DOE decided–at its own option and nowhere required by law–to use rulemaking to establish the guidelines for selecting from among multiple sites has no bearing on the most appropriate way to establish criteria for evaluating the suitability of a single site. These are two separate and distinct actions. It is, therefore, appropriate that DOE test its repository safety case against these criteria at this time even though they have not been published as a final rule.

Since the comment period on proposed Part 963 closed in February 2000, DOE has evaluated the input it has received. Over the past year, the only obstacle preventing a final rulemaking on these criteria has been the issuance of the EPA standard–finalized on June 13, 2001. Now only the administrative process needs to be complete before the criteria can be issued final. Given that there was never any requirement in the NWPA or elsewhere to promulgate these criteria as a rule, and the criteria are now substantively "finished," administrative rulemaking processes should not constitute a barrier to DOE's consideration of a site recommendation based on the best available science measured against the criteria in Part 963.

**f) DOE has satisfied the site recommendation prerequisite requirements of the Nuclear Waste Policy Act.**

While Section 113 of the NWPA requires the Secretary to establish criteria to determine the suitability of the site (a requirement that DOE has satisfied as discussed above in comment 1.e.), the NWPA does not specify when the

Secretary must make this determination. It is therefore entirely at the Secretary's discretion regarding when to consider a site recommendation.

The NWPA does, however, require, in Section 114, that the Secretary make public and receive comments on such considerations before making the recommendation. Over the past four months, DOE has presented and received public input on four major science reports that compile and evaluate the results of 20 years of scientific research. These activities provide a solid basis for concluding that the Secretary has sufficient scientific information to exercise his discretion to consider a possible site recommendation and has also met the Section 114 requirements for making this consideration public.

As discussed in comments 1a) through k), the scientific information presented by DOE is thorough and shows that a repository at Yucca Mountain can protect public health and safety in accordance with EPA's radiation protection standard. Although science will continue to advance and learn more about the project, the Secretary is under no obligation to wait for any additional scientific developments. What is now known is sufficient to take the next step, and, beyond this step, the NRC licensing process will address new information.

With the release of the PSSE, DOE has announced that it will soon be closing out what will have been a 5 month public comment period on a possible site recommendation. This period will include three hearings at locations near Yucca Mountain, which satisfy the NWPA Section 114 requirement for "hearings in the vicinity of Yucca Mountain."

Even before the NWPA required hearings, public interaction on DOE's scientific safety case has been exhaustive. Numerous public meetings have been held over the past 4 months in the vicinity of the site involving DOE and the Nuclear Regulatory Commission staff, the Nuclear Waste Technical Review Board, the Advisory Committee on Nuclear Waste, and a peer review panel assigned to review DOE's work.

The scientific information summarized in the PSSE was made available in these meetings and was discussed extensively. Opportunities for public comment were provided in each of these interactions, and DOE has been responsive to concerns raised by the public in these meetings. DOE responsiveness is specifically addressed in our detailed comment 1k). DOE also held public hearings for public comment on a supplement to its Draft Environmental Impact Statement during this time.

In short, none of the scientific results presented in the PSSE are new to the public. DOE has not only met the public availability requirements of the NWPA, appropriately, it has exceeded them.

### g) DOE's conclusions regarding the longevity of the waste packages are backed by sound science

DOE's waste packages are designed to have a protective outer shell made of Alloy 22. This metal has evolved from more than 100 years of progressive experience with nickel-chromium alloys and is highly corrosion resistant when placed in conditions projected to exist at Yucca Mountain.

DOE is conducting experiments at various locations (Lawrence Livermore National Laboratory, the University of Virginia and the University of Western Ontario) to further test the ability of the waste container material to withstand a wide range of harsh thermal, geochemical and mechanical conditions. Preliminary analyses of the current waste container design found that they would last considerably longer than the 10,000 year regulatory compliance timeframe before even a small fraction of the containers would begin to lose their ability to completely isolate the wastes. This led to the conclusion in DOE's Yucca Mountain Draft Environmental Impact Statement (DEIS) that there would be no releases from the repository before 10,000 years.[3]

Concerns have been raised that DOE has been too optimistic in its assessment of the longevity of the waste containers. Concerns were raised that the temperatures associated with the higher-temperature repository design would cause unacceptable increases in container general corrosion or in other mechanisms leading to container failure (e.g., dealloying followed by localized corrosion, stress corrosion cracking). DOE has addressed these concerns with additional testing and analyses and reported the results in the S&ER and the SSPA. The results of these tests show that the estimated mean lifetime of the containers is actually much longer than previously estimated. Their analyses also indicated that, at most, one or two containers could fail relatively early due to improper heat treatment of the closure lid welds. However, the hypothetical mean dose rate caused by these postulated early failures is less than one millionth of the natural background dose that individuals living in the Amargosa Valley region already experience annually. Furthermore, DOE notes that even this extremely low dose is a conservatively high estimate.

Thus, decision-makers can be confident that the mean waste container lifetime is very long, and that even assuming a few early container failures, does not compromise public health and safety.

---

[3] Except for the very low probability disruptive scenarios of volcanism and human intrusion, which we discuss below.

**550952**

**h) DOE's safety case sufficiently addresses earthquake hazards.**

DOE has conducted extensive study and in-depth analyses of the earthquake hazards for the proposed repository, including detailed investigation of existing faults in the Yucca Mountain vicinity and convening an independent expert panel to evaluate seismicity and earthquake fault data to provide input into the repository performance assessment. Scientists have identified earthquake faults in the vicinity of Yucca Mountain, characterized the features of these faults, estimated the frequency of various magnitudes of earthquakes that might occur, estimated the potential earthquake effects, and determined the seismic hazard based on all of these factors.

DOE has evaluated the potential for earthquake hazard in both its pre-closure and post-closure safety assessments. Repository surface facility structures, systems and components that are important to safety will be designed to withstand the effects of an earthquake. Proven engineering techniques will be used to design these safety features.

Earthquakes are less of a concern in the subsurface facility. Vibratory motion underground is significantly less than at the surface where most of an earthquake's destructive force is released. Furthermore, DOE's subsurface facility will be designed to avoid locating structures, systems and components near faults that have a significant potential for fault displacement. This safety strategy provides assurance that the repository surface and subsurface facilities will be designed to perform their safety functions in the event of an earthquake in the vicinity of the proposed repository at Yucca Mountain.

**i) DOE's safety case adequately addresses the potential "fast pathways" for water movement through the mountain**

DOE has evaluated the transport of radionuclides through the dry rock surrounding the proposed Yucca Mountain repository (a geologic region known as the unsaturated zone – or UZ) using a particle-tracking computer code. The results of this evaluation are then used as input to the TSPA-SR, which will form the basis for determining the suitability of the site. This computer model produces estimates of radionuclide transport through the unsaturated zone (UZ) that are conservative – especially for radionuclides, such as neptunium, that sorb onto minerals in the UZ. EPRI studies indicate that, actual travel times for neptunium through the UZ (between the repository horizon and the saturated zone – some 300 meters below the repository) may be ten to 100 times longer than that predicted using the existing particle tracking code. Alternate computer codes used in some of the SSPA calculations suggest that UZ travel time for significant radionuclides is

typically on the order of 1,000 years or more. Therefore, the DOE's particle-tracking model used in the TSPA-SR conservatively predicts earlier and larger releases than would be anticipated in nature. DOE's conclusion in the SSPA, that the particle-tracking algorithm be modified to model the interaction between fractures and the matrix in the UZ more rigorously, is therefore valid.

The observation of $^{36}Cl$ at the elevation of the repository indicates that at least some pathways from the surface exist that allow travel times of less than 50 years. This observation is not inconsistent with the current conceptual model of mass transport through the UZ that indicates radionuclides will follow a potentially diverse set of transport pathways. This conceptual model for UZ flow has been evaluated through various model studies. It is clear that existing mathematical models of the UZ are able to capture the observed trends in $^{36}Cl$. With a variety of scenarios, the modeling showed that no more than about 1 percent of the mass of a radionuclide, such as $^{36}Cl$, applied at the ground surface could reach a potential repository after about 50 years. Such a small amount of tracer transporting through the repository relatively quickly is not significant with respect to health impacts to individuals living in the area. In the unlikely event of a package failure before 10,000 years, the greatest proportion of the mass would involve travel times of 5,000 to 20,000 years – well above the 1,000-year Groundwater Travel Time requirement in 10 CFR Part 960.[4] A detailed examination of the simulation results shows that this fast flow occurs along major faults like the Solitario Canyon and Ghost-Dance Faults. Since waste containers will not be placed next to these faults, these fast flow phenomena are also avoided.

**j) DOE's safety case adequately addresses the possibility of future human intrusion into the repository.**

DOE is required to address the potential radiological impacts of a human intrusion scenario into the repository and show that the repository design will perform as intended. This scenario assumes that someone drills for groundwater at Yucca Mountain and the drill penetrates the repository and a waste package at some time in the future. The analysis conservatively assumed that the drill continues down for another 300 meters to the water table and that this human intrusion event occurs at 100 years (even though it is unlikely that a drill could penetrate a waste package without the drillers recognizing that they encountered a metal object or that memory of the repository's location would be lost a mere 100 years after its closure). DOE determined that the mean peak dose during the first 10,000 years after

[4] As discussed earlier, 10 CFR Part 963 eliminates "subsystem performance standards" such as the Groundwater Travel Time requirement because they do not have direct relevance to public health and safety.

repository closure would be less than 0.01 mrem/year, occurring at approximately 1,000 years.

DOE's evaluation of possible human intrusion into the repository indicates that the repository system is robust and resilient to potential disruption caused by the human intrusion.

**k) DOE has, in the PSSE and its predecessor documents, demonstrated that it is able to effectively respond to external concerns regarding its repository safety case.**

It is appropriate that the DOE program for Yucca Mountain be subject to comprehensive public and regulatory scrutiny. In addition, scientists and engineers employed by DOE and its contractors to work on Yucca Mountain should have the opportunity to express their concerns and have their concerns acted upon.

Many individuals and organizations have provided input to DOE during the Yucca Mountain site investigation process. Furthermore, DOE has organized many peer reviews of various aspects of its work. Throughout the site characterization process, DOE has been open to criticism and differing interpretations and has conducted additional work to address those concerns. A few examples of DOE's responsiveness are summarized here.

- A Yucca Mountain project employee was concerned that certain seismic activity could cause the water table to rise above the repository horizon such that the waste containers would become submerged under water. DOE conducted an extensive peer review, including a panel organized by the National Academy of Sciences, to evaluate this concern. After much additional study, it was concluded that this phenomenon would not occur.
- Project scientists have also presented a variety of other test results and analyses that have been potentially unfavorable to the Yucca Mountain site. For example, work performed at Los Alamos National Laboratory first identified the presence of elevated levels of $^{36}Cl$ at the repository horizon. Other scientists from the USGS and Lawrence Berkeley National Laboratory found that more recent data showed the amount of rainwater infiltrating deep into Yucca Mountain was significantly greater than previously thought. DOE presented these results to the public and undertook additional studies and design changes to address these findings.
- The U.S. Nuclear Waste Technical Review Board (NWTRB) has provided a series of recommendations to DOE since its inception. One recommendation was that DOE should dig an additional tunnel across the proposed repository horizon to examine rock properties and groundwater

**550952**

flow behavior. DOE agreed that this would be useful and has since completed the additional tunnel, which is used extensively for enhanced site studies. The NWTRB has also expressed concern about a repository design that would result in temperatures above the boiling point in the repository and surrounding rock. The NWTRB is concerned that there may be considerable, additional uncertainty in thermally coupled processes that may exist for such a higher temperature design. The NWTRB was also concerned that many of the uncertainties in earlier DOE performance assessments had not be adequately quantified. The SSPA, forming part of the basis for the PSSE, was developed largely in response to these two NWTRB concerns.

- The State of Nevada recently raised a concern about possible waste container failure mechanisms due to a thin layer of highly concentrated liquid at elevated temperatures it postulated could occur. In response, DOE has expanded both its testing and analyses of the waste container material to address this concern. The SSPA provides analyses, summarized in the PSSE, that concludes the particular combination of chemical species at very high concentrations and elevated temperatures is very unlikely to occur. DOE continues additional work to provide further confidence that this conclusion is correct.
- A group of researchers outside the DOE organization provided evidence to suggest the rate of expansion of the southwestern Great Basin was greater than DOE has postulated. DOE has since embarked on additional measurements to evaluate this concern.
- DOE organized a series of expert elicitations and peer reviews to assess DOE data and models. In the mid 1990s, DOE conducted a series of expert elicitations on the following subjects: volcanic hazard probability estimation; seismic hazard probability estimation and characteristics; waste package degradation; near-field environment; unsaturated zone flow and transport; and saturated zone flow and transport. More recently, a peer review, organized by the International Atomic Energy Agency, was completed of DOE's biosphere modeling. Currently, the Organization for Economic Cooperation and Development/Nuclear Energy Agency is conducting a peer review of DOE's TSPA-SR.

The above examples demonstrate that has been effective in both listening and responding to scientific and technical issues raised.

**550952**

2) **Specific responses to DOE's "Suggested Topics for Public Comment on Yucca Mountain**

   a) **Please provide your views concerning whether the Yucca Mountain Preliminary Site Suitability Evaluation (PSSE) and other scientific documents produced by the Department provide an adequate basis for finding that the Yucca Mountain site is suitable for development of a repository. If you believe that certain aspects of the PSSE are inadequate, please detail the basis for this belief and indicate how the documentation might be made adequate with respect to these aspects.**

   Based on the scientific safety case presented by DOE during this public comment period and additional information that is available, we conclude that the Yucca Mountain site is suitable for development as a repository. Our bases for reaching this conclusion are detailed in comments 1) and 3) of this enclosure.

   b) **If the Secretary determines that the scientific analysis indicates that the Yucca Mountain site is likely to meet the applicable radiation protection standards established by the Environmental Protection Agency and Nuclear Regulatory Commission, do you believe that the Secretary should proceed to recommend the site to the President at this time? If not, please explain.**

   Yes, the Secretary should proceed to recommend the site to the President at this time. The DOE has developed robust analyses that have reached sufficient maturity for the President to develop an informed opinion.

   c) **Are there any reasons that you believe should prevent the President from concluding that the Yucca Mountain site is qualified for the preparation and submission of a construction license application to the Nuclear Regulatory Commission?**

   No, the scientific evidence shows that the site is qualified for the preparation and submission of a construction license application to the Nuclear Regulatory Commission.

**d) If you believe that the Secretary should not proceed with a recommendation to develop a repository at Yucca Mountain, what mechanism should be utilized to meet the Department's legal obligation to begin accepting spent nuclear fuel and high level radioactive waste?**

We believe that the Secretary should proceed with a recommendation to develop a repository at Yucca Mountain. Furthermore, the Secretary must meet the legal obligation to begin accepting used fuel and high-level radioactive waste regardless of what mechanism is deployed.

DOE's legal obligation is unconditional, and DOE has had a period of several decades to determine how to meet it. It is not appropriate for DOE to reopen the topic of how this obligation can be met during this comment period that should be limited to public consideration of a possible Yucca Mountain site recommendation. The agency should remain focused on this goal and make its decision based on the scientific evidence.

**e) If you believe that the Secretary should not proceed with a recommendation to develop a repository at Yucca Mountain, what measures should the Nation consider for assuring safe disposal of spent nuclear fuel and high-level radioactive waste?**

We believe that the Secretary should proceed with a recommendation to develop a repository at Yucca Mountain. Furthermore, we agree with the National Academy of Sciences that geologic disposal is the only "scientifically and technically credible solution."

Additionally, we reiterate the point made above in response to question 2d) that the subject being considered here should be limited to a possible Yucca Mountain site recommendation. It is, therefore, not appropriate in this activity for DOE to reopen the question of how it might otherwise satisfy its unconditional obligation to accept used fuel and high-level radioactive waste in this context.

**f) Please provide any other comments concerning any relevant aspect of the Yucca Mountain site for use as a repository, or that are otherwise relevant to the consideration of a possible recommendation by the Secretary.**

A comprehensive discussion of our reasons for selecting the Yucca Mountain site is provided in comments 1) above and 3) below.

550952

**3) Additional information not provided by DOE that provides additional confidence in the Yucca Mountain site.**

The nuclear industry has achieved an impeccable record of safety unmatched by any other industry. Our commitment to safety is the foundation of everything we do, and is the central reason that nuclear power plants are the most reliable sources of electric generation in the nation.

This commitment does not end at the plants. We understand that the safety of used fuel disposal is a reflection on our industry. That is one reason why industry conducts its own scientific repository evaluations through EPRI – the industry's research center. The results of these evaluations are discussed in comment 3d) below. EPRI's scientific results confirm those published by DOE in the PSSE and its predecessor documents. These results also show that used fuel disposal can be safely accomplished at Yucca Mountain.

Industry's confidence in the safety of Yucca Mountain is therefore backed by our own unwavering commitment to safety and bolstered by more than simply DOE's impressive scientific results. Furthermore, confidence that the project is in the best national interest stems from more than just the fact that it is safe. The comments below elaborate on both points. They state industry's basis, beyond DOE's scientific safety case, for concluding that the Yucca Mountain Site should be recommended. .

**a) The proposed disposal project has significant nation-wide benefits that far outweigh risks of the extremely low potential radiation exposures indicated by DOE's scientific results.**

The decision to proceed to the next step in the process to license, construct, operate and eventually close the proposed repository will provide significant nationwide benefits by supporting the continued operation of our nation's fleet of nuclear power plants. At the present time, 103 operating nuclear power plants supply approximately 20 percent of our nation's electricity and provide environmental benefits as well as electricity supply benefits.

Recently, our nation has seen increasing evidence of fossil fuel cost volatility. This volatility has helped to emphasize the need for a continued reliance on nuclear power as part of a diverse and balanced energy mix.

More importantly, increases in nuclear electricity generation have almost completely displaced the use of oil as a fuel for electricity generation. This has reduced our nation's reliance on unstable parts of the world (such as the Middle East) for energy resources. Deployment of electric or hydrogen-

powered vehicles in conjunction with an expansion of nuclear generation could further enhance our energy and national security.

In addition to nuclear energy's role in helping to provide a balanced energy mix, there are also numerous environmental benefits associated with the use of nuclear energy for electricity production.

- Of all energy sources, nuclear energy has perhaps the lowest impact on the environment, including water, land, habitat, species and air resources. Nuclear energy is the most eco-efficient of all energy sources, because it produces the most electricity in relation to its minimal environmental impact.
- Nuclear energy is the world's largest source of emission-free energy. Nuclear power plants produce no controlled air pollutants, such as sulfur and particulates, or greenhouse gases. The use of nuclear energy in place of other energy sources helps to keep the air clean, preserve the Earth's climate, avoid ground-level ozone formation and prevent acid rain.
- Between 1973 and 2000, nuclear generation avoided the emission of 66.1 million tons of sulfur dioxide and 33.6 million tons of nitrogen oxides.
- Each year, U.S. nuclear power plants prevent 5.1 million tons of sulfur dioxide, 2.4 million tons of nitrogen oxide, and 164 million metric tons of carbon from entering the earth's atmosphere.

Nuclear power plants were responsible for nearly half of the total voluntary reductions in greenhouse gas emissions reported by U.S. companies in 1998, the Energy Information Administration reported on January 4, 2000. ("Emission reductions from nuclear energy usage reported by the electric power sector increased by 43 percent from an estimated 70 million metric tons carbon dioxide equivalent for 1997 to 100 million metric tons carbon dioxide equivalent for 1998"). That 100 million metric tons equals 47 percent of the 212 million metric tons of carbon emissions reductions reported nationwide, according to EIA.

Throughout the nuclear fuel cycle, the small volume of waste by-products created is carefully contained, packaged and safely stored. As a result, the nuclear energy industry is the only industry established since the industrial revolution that has managed and accounted for all of its waste, preventing adverse impacts to the environment.

The industry recognizes that it is not possible to predict what effect a repository at Yucca Mountain would have on the prospects for future nuclear electric power generation. However, it can be said with certainty that those prospects – and the environmental benefits that come with them – would be stronger if the repository is built at Yucca Mountain.

**550952**

**b) A rigorous NRC licensing process will independently evaluate the design and operation of a repository at the Yucca Mountain site.**

If the President approves the Yucca Mountain site, the step-wise NRC licensing process (consistent with the previous and most recent recommendations of the National Academy of Sciences) will ensure that the best science is always applied to assure public health and safety and protect the environment. The NRC will make separate licensing decisions at three distinct points–construction, operations, and facility closure. Changes in the project during these phases, as scientific knowledge advances, will be subject to the scrutiny of the NRC license amendment process.

The licensing process is rigorous and flexibile to maintain confidence in project safety as it evolves over several decades of repository operations. Additional scientific confidence is provided by DOE's decision to maintain access to the repository for up to 300 years (1) in the event advances in technology permit treatment of used fuel to reduce waste volume, (2) to facilitate other uses of the fuel, or (3) if advances in science suggest modifications to the Yucca Mountain project are necessary.

**c) International scientific consensus on geologic disposal supports both the repository development process DOE is undertaking and a decision to move forward and take the next step in that process.**

The National Academy of Sciences first recommended geologic disposal in 1957. This recommendation became the foundation of US nuclear waste management policy in the 1970s. Congress has built upon this foundation in waste management legislation, directing DOE to pursue geologic disposal–the NWPA of 1982, its 1987 Amendments, and the 1992 Energy Policy Act (which clarified disposal regulatory objectives based on NAS recommendations). This year, the NAS Board on Radioactive Waste Management reaffirmed the longstanding scientific consensus behind geologic disposal in a report entitled *Disposition of High-level Waste and Spent Nuclear Fuel.* This report urged national governments to "provide the leadership and support for solving the problem of nuclear waste" and concluded that "geologic disposal remains the only long-term solution available." Consistently, all nations currently pursuing long-term management of used nuclear fuel are investigating geologic disposal.

The 2001 NAS report further recommended that the nations pursue a "step-wise" repository development process. DOE has been and is continuing to follow such a process, one that consists of the following steps:

- a multi-site screening and ranking process (1982-1986)
- characterization of the highest ranked site, Yucca Mountain (1987-2001)
- a national site recommendation decision on Yucca Mountain (2001)
- a rigorous three-step NRC licensing process (beginning in 2002 if the site recommendation is approved)

NAS, in the 2001 report, also recommended that these processes be "open, transparent, and broadly participatory." As stated in comments 1f), 1k) and 3h), each step of the process taken so far has included extensive public involvement and provided ample opportunity for comment. The NRC licensing process will include a significant public participation component.

Therefore, not only is DOE pursuing *the* scientifically preferred method of waste management (geologic disposal) at Yucca Mountain, but they are doing so by following a process (step-wise/participatory) that is scientifically supported. The results of this process indicate that public health and safety can be protected at Yucca Mountain. These results, backed by 20 years of site specific study at Yucca Mountain as well as 40 years of international research, support continued forward movement in the process.

**550952**

**d) The federal government has an obligation to act.**

Since the beginning of commercial use of nuclear energy, the government has always been responsible for safely disposing of used fuel from commercial nuclear power plants. This responsibility was reaffirmed and strengthened by the following actions:

- 1974, the Energy Reorganization Act specifically tasked the Energy Research and Development Administration (the predecessor of DOE) with the responsibility for long-term management of used nuclear fuel and defense high-level radioactive waste.
- 1981, DOE issued a Record of Decision concluding that geologic disposal should be pursued.
- 1982, the NWPA codified US policy on geologic disposal and mandated that consumers of nuclear energy pay a one mill per kilowatt-hour fee to pay for the federal disposal program (by 2001 consumers have committed $17 billion for this purpose)
- 1987, after nine sites in six states are studied, Congress reaffirms US policy on geologic disposal and amends the NWPA to require that the Yucca Mountain site be the only site to be evaluated.

The 1982 NWPA created an obligation for the federal government to begin removing used nuclear fuel from reactor sites in 1998, but the federal government missed this deadline. Subsequently, DOE (in the 1998 *Viability Assessment of Yucca Mountain*) committed to a path forward that would involve a decision on Yucca Mountain, based on the results of the scientific investigations, in 2001. That time has arrived. The scientific results are in, and they show that the Yucca Mountain site is capable of protecting public health and safety. There is now no scientific reason for DOE to delay the development of a federal repository. Electricity consumers deserve the disposal services for which they have paid. The Secretary of Energy should recommend Yucca Mountain as the site to be developed as a repository.

**e) Transportation of used nuclear fuel and defense waste to the repository is safe.**

For almost four decades, the commercial nuclear power industry has transported almost 3,000 domestic shipments of used nuclear fuel and more than 21,000 international shipments without a release of radioactive material to the environment. This exemplary transportation safety record is the result of transportation regulations designed to enhance safety, criteria for transport package design and licensing that produce strong, robust transportation casks to withstand severe accidents, rigorous procedures for conducting operations, and extensive training. All of this historical

transportation experience is directly applicable to the future shipments contemplated for the DOE federal repository program.

Previous and more recent NRC evaluations of transportation accidents under severe conditions, such as *Shipping Container Responses to Sever Highway and Railway Accident Conditions* (NUREG/CR-4829, often referred to as the "modal study") and *Reexamination of Spent Fuel Shipment Risk Estimates* (NUREG/CR-6672), indicate that the risks associated with used fuel transportation are extremely low. The results of the transportation related aspects of the Yucca Mountain DEIS and the Private Fuel Storage Project DEIS support this conclusion.

The significant history of safe domestic used fuel transportation, and the analysis supporting the determination that transportation risks are extremely low, provides strong support for a positive site recommendation.

**f) EPRI's independent performance assessment of the proposed Yucca Mountain repository finds DOE's scientific results to be very conservative.**

EPRI has been conducting independent total system performance assessments (TSPAs) of the proposed Yucca Mountain repository since 1989. In its most recent TSPA, completed last year, EPRI investigated a series of conservatisms in the DOE TSPA-SR work [EPRI, 2000, Appendix A]. These conservatisms included both natural and engineered systems. The result of the EPRI analyses was a considerably lower (~100 times less) peak dose rate than that presented in TSPA-SR. Subsequent DOE analyses presented in the SSPA investigated many of these conservatisms with similar results for the peak dose rate. These analyses serve to further increase confidence in the suitability of the Yucca Mountain site.

**g) Natural analogues should be emphasized to a greater extent than what DOE has presented thus far in making a site recommendation.**

In the PSSE and the S&ER, DOE has indicated that it has relied upon natural and man-made analogues to help ensure that its total system performance assessment models "adequately represent the long term behavior of the geologic setting and engineered barriers." These analogues have provided an important input to the analytical process. The understanding of how geologic features and man-made artifacts have performed over thousands of years in the past lends a sense of reality to DOE's projections of how the repository will perform in the future. They provide a useful test of DOE's assumptions and expert judgment. They provide an important measure of confidence to analysts who must construct scientific models in the face of uncertainty.

Although the importance of analogue information to DOE in constructing credible repository performance models should not be underestimated, this purpose is not the only, or even the most beneficial, use of this information. Natural analogues should be more than an input to DOE's safety case; they also should be a fundamental output of DOE's efforts to communicate the safety case. Historical artifacts such as pyramids, cave paintings, naturally occurring nickel-based metals and natural uranium deposits are the most convincing evidence that exists regarding the long-term survivability of materials such as those in DOE's waste containers. Most of these objects have existed for thousands of years in environments less favorable to long-term survivability than Yucca Mountain.

Analogues are understood by a wide range of audiences and provide tangible and visible proof that processes that occur over thousands of years can be observed. As such, decision-makers and stakeholders should be presented with the analogue information itself, not just informed that such information was used in developing the safety case. This will help all involved in the decision process reach their own conclusions about DOE's analysis.

**h) DOE's repository safety analysis methods are internationally respected.**

Many of the safety analysis methods used by DOE are now in common use throughout the world. DOE has pioneered innovative methods of determining rock properties and assessing unsaturated flow systems in porous, fractured rock. DOE is also collecting groundbreaking information on some of the materials to be used for the drip shield and waste container that will be used internationally. The quality of the work is demonstrated by the many articles that have appeared in peer-reviewed journals and in the peer-reviewed proceedings of conferences. DOE's analytical methods are often used as a model for developing international approaches to repository design, such as those developed by Organization for Economic Cooperation and Development/Nuclear Energy Agency, and the International Atomic Energy Agency.

DOE also participates in a host of international cooperative programs to jointly develop methods and approaches for developing repositories and assessing repository performance. Thus, DOE is not only in a position to lead, but also has learned much from these international cooperative activities.

550952

**i) The Yucca Mountain site has significant advantages that make it well suited for geologic disposal.**

Yucca Mountain's distinct natural advantages make DOE's proposed repository less dependent on engineered barriers than other proposed repositories around the world. The relevant advantages of the Yucca Mountain over these sites are:

- Yucca Mountain is in an arid region. This limits the amount of water flowing through the repository, thus limiting the rate at which waste packages degrade so that radionuclides could escape. Other sites under investigation are in much wetter climates where more water is available to transport wastes into the biosphere.
- The repository horizon at Yucca Mountain is above the water table in the unsaturated zone. This unique advantage of Yucca Mountain means that only a fraction of the waste containers will ever have groundwater flowing over them. Other sites under consideration elsewhere in the world are below the water table, so are subject to 100 percent immersion. Because the Yucca Mountain candidate repository is above the water table, the drip shield design can be used to eliminate active dripping by groundwater on containers for thousands of years. Other sites require additional engineered barriers (compacted bentonite) or natural features (salt or clay formations) to limit contact with flowing groundwater. However, neither bentonite nor salt or clay formations perform as well as the volcanic tuff of Yucca Mountain when the waste is generating significant heat.
- Sites using bentonite or in clay or salt formations must limit the amount of decay heat in the waste package resulting in disadvantages the Yucca Mountain site does not share. Other sites must employ reprocessing, smaller waste containers, and/or *very* long storage times prior to disposal to lower the heat output adequately. This adds both cost and worker exposure. Because the Yucca Mountain design allows for direct disposal of spent fuel, both costs and worker exposure are reduced. In this sense, it is easier to dispose of spent fuel at Yucca Mountain than at other sites.
- Yucca Mountain is in an area of limited natural resources. Thus, the likelihood of human intrusion is much lower than at other sites where natural resources are more abundant.

**j) The scientific results DOE has presented validate the reasons that Yucca was originally selected from among nine sites in six states in the 1980s**

Section 1.2 of the PSSE briefly discusses the history of geologic disposal investigations in the United States. Therein, it is mentioned that the favorable characteristics of the desert regions of the southwest led the USGS to first begin investigating the Yucca Mountain site in the 1970s. It is notable that the scientific hypothesis that Yucca Mountain might be a suitable site for repository development has withstood so many years of scrutiny–and, as the PSSE demonstrates, that this hypothesis is scientifically supported today more than ever. However, DOE's brief summary of the project's history does not provide a complete picture of the full extent of the scientific basis that existed behind the decision to study Yucca Mountain in the first place. This is unfortunate, because revisiting this original basis in light of what has been learned since then, adds additional perspective on the pending decision and further supports moving forward with Yucca Mountain.

Following the 1982 NWPA, DOE embarked on a multi-site investigation process. In 1983, nine potentially acceptable repository sites were identified in six states. The candidate sites were:

- Vacherie Dome, LA
- Cypress Creek Dome, MS
- Richton Dome, MS
- Yucca Mountain, NV
- Deaf Smith County, TX
- Swisher County, TX
- Davis Canyon, Utah
- Lavender Canyon, Utah
- Hanford Site, WA

In 1984, draft environmental assessments were prepared for each of these sites, written and oral public comments were solicited, and public hearings were held to discuss these assessments. In 1986, following consideration of the input received, DOE nominated five of the sites as suitable for characterization, finalized the Environmental Assessments for each of the sites, and conducted a "Multi-Attribute Utility Analysis" of the nominated sites–comparatively ranking them against factors important to the protection of public health and safety.

The results of DOE's Multi-Attribute Utility Analysis (DOE/RW-0074) are particularly instructive with regard to the choice of Yucca Mountain.

Quantitative measures of potential performance for a number of pre and post closure attributes (judged to be relevant to protecting worker and public health and safety) were developed and applied to each of the sites. The results indicated that all five sites were "well qualified," and the comparative analysis of environmental impacts (both pre and post closure); socioeconomic effects, transportation, operational considerations and costs resulted in a composite ranking as follows:

1st – Yucca Mountain, NV
2nd – Richton Dome, MS
3rd – Deaf Smith, TX
4th – Davis Canyon, UT
5th – Hanford, WA

With these results in hand, Congress in 1987 redirected the DOE program to focus solely on Yucca Mountain. In 14 years since, $4 billion in scientific study has been conducted specifically at Yucca Mountain and nothing has been found that casts doubt on the merits of this choice.

A decision to move forward at Yucca Mountain is, therefore, supported by DOE's prior multi-site investigations. This is an important point that DOE should communicate along with its site recommendation, because it shows that the site characterization process had not only a credible end point (in the PSSE) but also a credible starting point. This demonstrates that DOE has, since the very beginning, been following a "step-wise" process consistent with the recent recommendations of the National Academy of Sciences. In addition, the original comparison would be useful in informing decision-makers of the choice that would remain should a Yucca Mountain site recommendation not be approved–since geologic disposal remains the only scientifically supported long term option.

**k) DOE's analysis overstates the potential for damage to the repository due to volcanoes.**

While the DOE probability-weighted mean dose estimate due to volcanic activity is 0.1 mrem/year before 10,000 years (more than 100 times less than the EPA limit), it is apparent that there are many conservatisms in the DOE approach that, if removed, would further lower this dose estimate. A few examples are provided here:

- Independent scientific evaluations indicate that the probability of volcanic disruption is closer to $10^{-8}$ per year rather than the higher $10^{-7}$ per year value in some of the DOE analyses. The basis for the Probabilistic Volcanic Hazard Analysis (PVHA) panel mean probability of $10^{-8}$ per year

is still fundamentally sound. Evidence reported by the NRC's Center for Nuclear Waste Regulatory Analysis regarding the existence of a few additional, old volcanic centers in the general Yucca Mountain region should not be considered cause for changing the PVHA probability, let alone increasing the probability of volcanism causing disruption in the repository by nearly an factor of ten. This is supported by DOE analyses presented in the S&ER that states "Sensitivity studies showed that these new data did not significantly affect the results of DOE's hazard assessment."

- DOE notes that, in the SSPA, doses increased by about 2.5 times (over the estimate in the TSPA-SR) "due to the increased small particulate of concentration in the air" as a result of conservative particulate size assumptions. Particle sizes are quite important because these are in the respirable fines size range, which causes inhalation dose estimates to be very high. More reasonable assumptions regarding particulate size could lower dose estimates significantly.
- The contents of all waste containers fully or partially damaged are assumed to be fully available for transport to the accessible environment. Partial encapsulation of the waste by magma was neglected. It is more likely that only a fraction of the waste in the damaged containers would be released in this fashion.
- The entire volume of material involved in the event is assumed to have evolved in the most violent phase of the eruption (hence, will be carried farther downwind than if it had been ejected during a less violent portion of the eruption). DOE notes in the SE&R that there is evidence this is a significant conservatism.
- Recent analyses[5] conducted by the Center for Nuclear Waste Regulatory Analysis suggest that there could be significantly higher container disruption due to multiplication of the pressure pulse as it reflects from the end of the waste emplacement tunnels. These analyses appear to be mostly a theoretical exercise based on a simplified system. In reality, the magnitude of the pressure pulse will most likely be lower – perhaps significantly.

l) **Because scientific advances will continue throughout the repository development process, DOE should make its performance confirmation program an integral part of its license application to the NRC.**

29

[5] Analyses presented after the release of the SSPA.

The technical bases for a possible site recommendation set forth in the PSSE and its supporting documents, while drawing on almost two decades of research and analyses, necessarily contain some uncertainties about the very long-term evolution of the candidate Yucca Mountain repository. The existence of uncertainty in the projection of consequences is the reason why both NRC and the U.S. Environmental Protection Agency recommend a risk-based approach to demonstrate that public health and safety will be adequately protected. Appropriate management of uncertainties should provide decision-makers confidence, that: 1) the design of the repository is sufficiently robust to withstand a range of insults to its integrity and still perform well enough to adequately protect future human health; and 2) even if the future evolution of the repository are not perfectly known today, confidence does exist that the potential consequences of disposal will be below conservatively established regulatory limits, and are not likely to have been underestimated.

NRC will be required to make separate determinations on whether to authorize DOE to first construct, then operate, and finally close the repository. These determinations will occur years apart. In the intervening time between decision-points, DOE's data and modeling projections will evolve. They will submit, under rigorous quality assurance standards, a series of updated analyses. The continuing scientific research program that will take DOE from the initial SR decision, through the licensing process, to the final decision to close the repository is known as "Performance Confirmation." Work done under this program is vital to demonstrating that future populations will be protected.

It is important to distinguish between tests, experiments, observations, and analyses conducted to support the site recommendation or initial construction authorization from longer-term performance confirmation programs associated with repository operations and closure. Decision-makers need to recognize these distinctions, and DOE should communicate its plans accordingly.

**m) In future licensing documents and public proceedings, DOE should refer to those living near Yucca Mountain as "persons" or "individuals," not "receptors."**

Throughout the Yucca Mountain Preliminary Site Suitability Evaluation, DOE uses the term "receptors," rather than persons or individuals, when discussing repository performance. While "receptor" may be a regulatory term-of-art, that should not preclude DOE from using the terms individuals or persons in its technical documents. Use of "individuals" or "persons" will

**550952**

convey that DOE is discussing the dose to people and not an inanimate object.

550952

"McCULLUM, Rodney" <rxm@nei.org> on 09/25/2001 02:01:06 PM

RECEIVED

SEP 25 2001

To: "'YMP_SR@ymp.gov'" <YMP_SR@ymp.gov>
cc: "TEAM, Used Nuclear Fuel" <srwaste@nei.org>

Subject: NEI written comments on a possible Yucca Mountain site Recommenda tion

**Part of Records Package / Supplement / Correction**

 - C.htm

 - SRNEIenclosure.doc

 - SRNEIletter.doc

32

550952

Attention: Carol Hanlon

This e-mail constitutes NEI's comment submittal in Response to 66 Fed. Reg. 23,013 (May 7, 2001), 66 Fed. Reg. 43,851 (August 21, 2001), and 66 Fed. Reg., and 66 Fed. Reg. 45,845 (August 30, 2001)

Letter and enclosure are in separate Microsoft Word Files.

thank you for your consideration, Rod McCullum (NEI)

33